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ABSTRACT

Until the last two or three years, three forces inhibited the acceptance of computer-assisted instruction (CAI). These were the fear on the part of traditional trainers of displacement by machines, the poor quality of existing courseware and limited capability of accompanying hardware, and the poor price and performance characteristics of existing hardware. More recently, however, several forces have begun to gather momentum and are now effecting a dramatic change in the technology of CAI. New CAI technologies that substantially reduce training time and travel costs, the development of more interesting and effective courseware, and the gradual acceptance of CAI as an effective method of instruction have all fostered the increased popularity of CAI instructional technologies. As the field of high-technology training matures, it is likely that the acceptance of computer-driven training methodologies will undergo an accelerated pace in all facets of business and industry. The forces contributing to this increased acceptance will stem from the continued popularity of educational games, from advances likely to emerge from work now being done in the area of artificial intelligence, and from the improved recordkeeping capability of stand-alone training systems that allow for immediate transfer of student records to a centralized mainframe database. (MN)

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EFFECTIVE USE OF NEW COMMUNICATION TECHNOLOGIES

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EFFECTIVE USE OF NEW COMMUNICATION TECHNOLOGIES

The new communication technologies, like other cutting-edge training technologies including CAI, have had many false starts during their brief twenty year history. Like computer based education many of these technologies are just now beginning to receive the acceptance they so richly deserve. By examining the forces that have shaped and influenced teleconferencing, videodisc, videotape, and particularly CAI, we can get a clearer picture of the probable use of these technologies in the immediate future.

From its earliest beginnings in the early 1960 s with the advent of programmed instruction and the teaching machine, training technology has been shaped and molded by a combination of inhibiting as well as accelerating forces. The purpose of this paper is to examine these warring forces, and in doing so provide insight as to the destiny of educational technology in the 1980s.

INHIBITING FORCES

Humans are Better than Machines:

In the early years of CAI and video-assisted learning--long before teleconferencing and videodisc appeared on the scene--most of the external forces coming in contact with the youthful, and distinctly immature technology were inhibitive rather than catalytic. CAI, of course, was an outgrowth of the technology of programmed learning, which was itself a derivative of the Socratic method with a bit of Skinner's theory thrown in for good measure.

With this anthropologic heritage it's understandable that many teachers, who have held humanistic values dear through the ages, found something objectionable in the concept of machines teaching people. Thus, one of the major forces inhibiting the acceptance of CAI was the belief by many educators that technology itself was somehow in opposition to human values. As a result, they viewed machines as inhibiting the successful and

efficient acquistion of knowledge, rather than as tools for facilitating human development. This attitude, as we shall soon see, has changed dramatically in the last two or three years. In the interest of classification, we can identify this force as a philosophic one--based purely on the human conceit that Man can teach better than machines.

Courseware Quality is Poor:

A second inhibiting force stemmed from the technology itself and was ultimately related to the quality of the courseware. Many of the first CAI and video-assisted courses--in fact the large preponderance of them--were absolutely terrible. Because of an excessive and misguided use of tutorial presentation strategies, they often lacked sparkle and were occasionally even boring.

With a youthful technology this might have been forgiven. Admittedly, it was awkward to use the inflexible authoring languages. Visual and audio stimulation was non-existant. The technology did not yet provide color, animation, sound, or speech synthesis. High resolution graphics had not been invented. Massive blocks of information--a carryover from programmed instruction days--were dumped on the hapless viewer. (I recently saw an early text on effective programmed instruction in which the author advocated individual frames of 300-400 words in length.) Simulation was rarely used. Games, which are now recognized as effective microcosms of real-world situations, were just beginning to be exploited. And in video training programs talking heads were the rule rather than the exception.

In the final analysis, the instructional limitations of the early course designs, authoring systems, and hardware were all too obvious, and the outcome, as could be expected, was tutorial lessons that were exceedingly tedious. These lessons failed in two important respects: they presented far too much information per frame, and they usually asked superficial questions. Thinking was rarely demanded of the student; rote memory was. We discovered to our dismay that although we were on the right track, we had merely created sleep-inducing video training, overstuffed text screens, and computerized page turning devices.

For humanistic teachers this provided ample room for neo-Luddite condemnation of the costly hardware and, proud as peacocks, they crowed, "See we can teach better than machines." The fact that new technologies in any field take time to develop and mature was, for all practical purposes, ignored. The final result: video was badly bloodied, while CAI went down for the count.

Technology is Costly:

A third inhibiting force, and probably most significant, was cost. Early high-tech training systems were expensive. As little as two years ago I used to tell trainees that I didn't know of a single company that had purchased a computer for training purposes alone. That is no longer the case, for due to the advent of low cost microprocessors, many businesses can now afford a sophisticated computer system dedicated solely to the training process.

Authoring systems used to be equally expensive. In the main-frame environment, systems like PLATO and Scholar/Teach III were prohibitively expensive. Among video-assisted delivery systems, TICCIT was far too costly for most companies to justify. Only organizations with tremendous numbers of trainees could cost-justify this level of product. Costs for some centralized systems are still high. Honeywell's CAN-8, for example, is $30,000 for a perpetual lease, and that doesn't include hardware.

Generally, however, the costs for software programs that make authoring CAI courseware possible are coming down almost as rapidly as hardware. Take PASS for instance. When this high-level authoring system developed by Bell & Howell first came on the market it was priced at $35,000 for most customers. This put it in the same league with the big, powerful, mainframe authoring systems. Almost immediately a price reduction was made available to selected users who were willing to abide by a few restrictions concerning the use of the courseware they developed with PASS. For these customers, PASS could be purchased for approximately $15,000. Within a year, a further reduction in the price of PASS was made when two complete sets of microcomputer hardware (one authoring station, and one trainee station) were included in the purchase of PASS with no corresponding price increase. In effect, this cut the price of PASS in half a second time.

The amazing news, however, is still to come. Just weeks ago a stripped-down version of PASS became available from Bell & Howell for less than $1,000. Named Ava it doesn't have all the bells and whistles of PASS, but it still has the genetic structure and basic architecture of the Professional Authoring Software System. Although PASS, as the leader in microcomputer authoring systems, is an excellent model for illustrating the decreasing cost of software, it is by no means unique. In fact, it was the competitive pricing of imitators of PASS that caused Bell & Howell to roll back their price on this excellent product.

Hand in hand with the shrinking cost of computers and interactive video devices is their increasing capability. We've all heard the wonderful analogy that if the automotive industry had developed at the same rate as the computer industry, you'd be able to by a Rolls-Royce for $2.75; it would do three million miles to the gallon; and it would deliver as much power as the Queen Elizabeth II. And, if you wanted to miniaturize it, you could get six of them on the head of a pin.

To summarize, then, there were three major inhibiting forces that slowed the acceptance of CAI in the early days. These could be classified as:

1. Traditional trainers fear of displacement
2. Poor Courseware and limited hardware capability
3. Poor price/performance characteristics of hardware

ACCELERATING FORCES

Time is said to change all things. And with adequate time, all things can be changed. This is particularly true in relation to the new training and communication tools.

Let's examine the forces which even now are gathering momentum to effect dramatic changes in the technology of CAI. . .changes which will result in accelerating the acceptance of CAI in the business community.

Time is Money:

First, there's TIME itself. In business there's unbelievable pressure to make every minute count. Time is no longer merely a question of money, it's the difference between survival and extinction for many corporations. The need to decrease learning time while maintaining and/or improving mastery of the subject being studied is becoming the focus of management's attention.

Of the numerous studies that have been conducted on CAI few have shown less than a 30% improvement in learning acquisition time. Here are some typical examples.

- United Airlines, "Results of Computer Based Training" Flight Training Center. Reduction of 37% in training time.
- GTE "Technical Training in Telephone Switching Systems" Reduction of 35%.
- Kemper Insurance "Cost Benefit Analysis of CAI" Reduction of 65%.

Many studies conducted under the most carefully controlled conditions have shown improvements in learning acquisition time that are truly remarkable. For example, the Computing Center at Florida State University conducted a study that showed an 83.3% improvement in training time for high school dropouts that were trying to pass the math equivalency test.

With increasing pressure placed on business educators to limit the amount of time trainees spend in class results like those cited above are becoming a potent force in accelerating the acceptance of CAI.

Travel is Costly:

The second force pushing business executives to take a fresh look at high-tech training is the increasing cost of travel. We seem to have reached the point of diminishing returns in relation to the cost of pushing

humans around the planet. Businesses everywhere are cutting back on travel, and the new communication technologies are strong contenders in the battle to curtail travel costs associated with training. Reduced travel expense alone is often enough to cost-justify a mechanized training system. When combined with improved mastery as well as reduced training time, it's possible to cost-justify almost any intelligently conceived training system in business today.

Courseware is Better:

These first two forces alone--reduced learning time and reduced travel costs--might have been enough to accelerate the business world's acceptance of CAI and other advanced training technologies.

However, with the decrease in the size and cost of computers, there has been a corresponding increase in power. (Remember our automotive analogy.) With this power has come heightened instructional capabilities. We're already making use of these new capabilities by designing courseware that's much more exciting--courseware that simulates the real-world--courseware that forces trainees to think.

We can now interlace videotape and videodisc segments into computer-based courseware, adding a pictorial dimension to what was once a rather dreary medium. Typing skills are no longer a prerequisite for using CAI programs. Sophisticated user/machine interfaces such as mice, light pens, and voice recognition devices have extended the potential audience for CAI exponentially.

Random access audio reinforcement is also coming into its own. Bell & Howell has a project dubbed "Mr. Facts" that uses this exciting new capability to guide auto mechanics through lessons on everything from air conditioning systems to electronic ignition repair. The mechanics don't even have to use the computer keyboard; they move through course after course by touching a light-pen, which is about the size of an ordinary screwdriver, to different points of the screen.

How do we know this new generation of courseware is better than the CAI courseware of ten years ago? What proof do we have that color, sophisticated graphics, improved response time, prescriptive testing and placement, dynamic branching strategies, audio reinforcement, and the increasing use of humor make for better courseware?

What proof do we have besides our own "gut" intuition? Recent studies have shown that a majority of students prefer to learn from computers than from human instructors. Not only do they learn just as much, but they learn it in less time. Not suprisingly, students today consider that a significant motivating factor.

Attitudes have Changed:

Perhaps the final accelerating force impacting the field of high-tech training is the altered perception of the individual toward the computer itself. We may still look down our noses at machines in general, but computers have become almost lovable. The electronic game phenomenon is entirely responsible for this exciting revolution. Computers can't be all that bad, reasons the adult educator, if my son (or daughter) spends six hours a week down at the local game emporium. Young persons' acceptance of the computer as a friendly "game player" is paving the way for general acceptance by the community at large.

When one combines this positive attitude with improved courseware, it's apparent that people are beginning to view a computerized training course as more exciting than the average teacher. A good CAI course will rarely be as good as the best teacher, but it will almost always be better than most teachers.

THE PROGNOSIS

It's frightening to think that in twenty years the kids who are playing computer games today will be our nations decision-makers. They'll have grown up with computers, used terminals through high school and college, and lived with the ever escalating process of automation. They will be used to automobiles that talk

to you when you start the engine, exotic word-processing systems, voice activated typewriters, wide ranging data bases for every imaginable function, artificial intelligence, and much, much more.

How will this intimate familiarity with new technology impact the process of education? Certainly, the computer as a teacher is just beginning to come into its own. As the field of high-tech training matures we'll see accelerating acceptance of computer-driven training methodologies in all facets of business and industry. The forces contributing to this acceptance will stem from three main areas.

Educational Gameware:

Early computer games like Space Invaders are already giving away to intellectual challenges of the genre of Rocky's Boots, created by the Learning Company of Portola Valley, California. The intellectual wasteland spawned by psychomotor games that reached their apogee in PacMan, are now being cross-pollinated by a new breed of game that allows the player to flex his or her logic skills within the parameters of the program's internal conventions.

The end result is the student's mastery of the computer as well as the game. In a real sense the player, like Tron, becomes part and parcel of the computer, moving fluid-like from room to room in Rocky's incredible house.

The movement from simple games to "educational gameware" is a movement away from pure pattern recognition toward sophisticated analysis and problem solving. This same transition occurs when youngsters move from checkers to chess. As the game process approaches reality in complexity, the educatinal value of the exercise increases correspondingly. There's nothing mindless about the game logic of Space Invaders, it is just too simple to be a useful educational tool.

Note that as arcade games become more complex, the "How to Beat Them" books become longer. As computer capabilities increase, logical complexities will create "games" which are fun and real learning experiences such as certain sophisticated Department of Defense computer-controlled war games.

Strong evidence that a new generation of sophisticated courseware is on the horizon can be seen in Verbatin's Ed Game Challenge. Administered by two leaders in educational computing, CONDUIT of the Univeristy of Iowa, and MicroSIFT, this contest seeks outstanding computer-based games that are both fun to play and instructive in a non-trivial subject. Contestants are cautioned to "make displays visually appealing, to use color and graphics where they will enhance and not distract, to keep text uncrowded and precisely written. . ." certainly good advice for any computer based training designer. A thorough review of their "tips on designing an instructional game" reveal an exceptionally clear statement of the rules of instructional design for computer based training. One marvels that this is advice to teen-agers who are competing for $500 in gift certificates rather than to doctorial candidates in the college of education.

The new generation of electronic games will certainly lead to new learning experiences, and the evolution of this technology will advance exponentially as today's children and game players become tomorrow's teachers and game designers. We'll have proof-positive that this is taking place if the winner of the Ed Game Challenge is under twenty years of age.

Artificial Intelligence:

A second way the new technologies will impact the process of education reveals itself in the work currently being done in artificial intelligence. Soon computers will be able to turn their power back onto themselves. In doing this they will not only be able to check the accuracy of their master's spelling, (as many word processing programs already do) but they will be able to effect advances and improvements in the instructional design itself.

As acceptance for CAI and other high-tech training and communication methods increases, more and more money will be poured into the tools needed to design tomorrow's courseware. This self-supporting capability will ultimately result in our ability to create even better courseware, which in turn will further accelerate the acceptance of the technology.

Up-loading and Down-loading:

The third and final way the new technologies will effect the field of industrial training and education concerns improved record keeping capability of stand-alone training systems, and the immediate transfer of those records to a centralized mainframe data base. The trend to up-line load student performance records to a corporate data base will eliminate the largest remaining obstacle from the path of high-tech industrial training.

We'll soon see that the architectural design of any computer controlled training system will incorporate the ability to down-line load courseware from a massive central courseware bank and up-line load student records. The technology already exists to accomplish this with computer based training, but to do so with other forms of interactive training will be a much more difficult task.

According to official ASTD statistics, training is a $30 billion a year business.[1] TRAINING magazine, in their landmark U.S. Training Census and Trends Report, 1982, states that 18.3% of the businesses they sampled were using computers for instructional purposes.[2] More significantly, in an earlier survey conducted by TRAINING magazine 70% of the respondents stated they anticipated using computers in training by 1986.

The pace of change is accelerating exponentially. Slightly over 100 years ago the world's first electronic data communication device was created. Less than twenty years ago educational technology began to capitalize on the new communication tools. Now we stand at the threshold of a mammoth communication revolution. The combined technologies of the telephone, computer, and television have merged into an integrated information and communication system that transmits data and permits instantaneous interactions between persons and computers.[3] Our challenge as professional educators and instructional designers is to capitalize on these ever expanding opportunities.

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